I CLAIM:

[00123] 1. An apparatus (10,10') for separating, a particle stream into particle groups, comprising:

[00124] an apparatus (10,10') having various geometric shapes and configurations, including a pre-treatment module (15), a dilution treatment chamber (12), a passageway (20), a transfer chamber (13), and nozzle (14)to separate/mix particles/fluid stream;

[00125] a generally parallelepipedic dilution treatment chamber (12) defining an upstanding passageway (20) ~~channel~~ having a particle stream inlet (21) at a top end, and a passageway outlet (22) first-particle group outlet at a bottom end, the passageway (20) ~~channel~~ being adapted to receive a particle stream at the particle stream inlet (21) such that the particle stream falls toward the passageway (20) first-particle-group outlet;

[00126] a generally parallelepipedic transfer chamber (13) ~~casing~~ adjacent to the dilution treatment chamber (12) and sharing a wall (23) between dilution treatment chamber (12) and a transfer chamber (13), which is ~~and defining a transfer chamber~~ adapted to receive a second particle group.

[00127] at least one transfer aperture (24) ~~second particle group outlet~~ laterally positioned with respect to the passageway (20) ~~channel~~ of the dilution treatment chamber (12) and allowing fluid flow jet communication between the transfer chamber (13) and the passageway (20)dilution treatment chamber(12) ~~channel~~;

[00128] a distributor, nozzle (14, 104) in the passageway (20, 102) ~~channel~~ between the particle stream inlet (21) and ~~the~~ at least one particle-group outlet,

for distributing ~~breaking down~~ the particle stream ~~and distributing the particle stream~~ over a surface area of the passageway (20) dilution treatment chamber(12) ~~channel~~; and

[00129] at least one dilution treatment chamber fluid flow aperture (25) in the dilution treatment chamber (12) and below the distributor, positioned opposite side to the transfer aperture (24) and adapted to create a fluid flow jet between the transfer chamber (13) and the passageway (20)dilution treatment chamber (12) ~~channel~~ so as to project, entrain particles group with different masses from the passageway (20) ~~channel~~ through and out of the particle stream toward the transfer aperture (24) in order to collect the separated particles groups of particle stream in the transfer chamber (13) and exiting by the transfer chamber outlet (31), or directed to the inlet of a second passageway (102). The particle stream that remains in the passageway exits by the passageway outlet (112), the second-particle-group outlet to the transfer chamber (30) with a first particle group remaining in the ~~channel~~ dilution treatment chamber (12) for exiting through dilution treatment chamber (22) outlet, the first-particle-group, the apparatus being adapted to be connected to a positive pressure source to create the pressure of the fluid flow and its magnitude, described like the force of the jet in relation with the momentum of the fluid jet impacting the particles stream, and jet momentum action transferred to particles/fluid stream which decelerate at a distance related to the surface area dimension of the nozzle outlet opening. In fact the deceleration is set in the transfer chamber (13)

which dimension is related for setting the particles which lost their momentum.

[00130] 2. The apparatus (10,10') according to claim 1, further comprising a pre-treatment module (15) at the particle stream inlet (21) of the dilution treatment chamber (12), to guide the particle stream and to ~~cause a horizontal~~ begin a dilution of the particle stream.

[00131] 3. The apparatus (10,10') according to claim 2, wherein the pre-treatment module (15) has at least one slide portion (53) sloping downwardly toward the particle stream inlet (21) of the dilution treatment chamber (12) for guiding and accelerating a particle stream to the dilution treatment chamber (12), and a deflecting surface (51) between the slide and the particle stream inlet (21) for breaking down the particle stream and for imparting the ~~horizontal~~ dilution to the particle stream.

[00132] 4. The apparatus (10,10') according to claim 1, wherein at least one of the dilution treatment chamber fluid flow apertures (25) is used to project/inject, fluid additive into the particle stream ~~first particle group~~.

[00133] 5. The apparatus (10,10') according to claim 1, wherein at least one transfer chamber aperture (24) second-particle-group outlet and at ~~the~~ least one dilution treatment chamber fluid flow aperture (25) are horizontally aligned and positioned on opposite sides of the passageway (20) ~~channel~~ of the dilution treatment chamber (12).

[00134] 6. The apparatus (10,10') according to claim 5, wherein at least one nozzle (14) projecting a fluid flow jet configuration adapted to control the rate of the fluid flow and pressure that emerges from it, with an adjustable gate (45) designed to create different pressure in the opening surface of the outlet (41) of the nozzle (14) to enhance different magnitude. Pressure rate of the fluid flow in the nozzle (14) is adapted to produce less or more force impacting the particle stream; the nozzle (14) is also adapted to be connected to the positive pressure source ~~is~~ and connected to the dilution treatment chamber fluid flow aperture (25) so as to project, inject fluid in the passageway (20) ~~channel~~ to create the fluid flow jet between the passageway (20) ~~channel~~ and the transfer chamber (13).

[00135] 7. The apparatus (10,10') according to claim 1, wherein the nozzle (14) distributor has an aperture (25) laterally positioned in the passageway (20) ~~channel~~, and a fluid-injection nozzle adapted to be connected to the positive pressure source and connected to the dilution treatment chamber aperture for projecting, injecting fluid in the passageway (20) ~~channel~~ of the dilution treatment chamber (12), for ~~breaking down~~ distributing the particle stream over a surface area and within the volume of the passageway (20) dilution treatment chamber ~~channel~~.

[00136] 8. The apparatus (10,10') according to claim 1, wherein the distributor is either an impeller (80), an ultrasound system, or a reciprocating strainer (90).

[00137] 9. The apparatus (10,10') according to claim 1, further comprising a recuperation tray (70),

positioned out of the passageway (20) channel in the transfer chamber (13) on the wall (23) sharing the dilution treatment chamber (12) and the transfer chamber (13) and below the transfer aperture (24), ~~second particle group outlet~~ for collecting particles of the first particle group deflected or forced out of the passageway (20) ~~channel~~ by the flow of fluid, and for returning particle, in the remainder of the particle stream. ~~the particles of the first particle group to a first particle group.~~

[00138] 10. The apparatus (10,10') according to claim 1, wherein the transfer chamber (13) ~~casing~~ has an outlet (31) at a bottom end thereof, for collecting the particle group received in the transfer chamber (13) casing.

[00139] 11. The apparatus according to claim 1, wherein the transfer chamber (30) of the transfer casing (13) is segmented into laterally adjacent upstanding receptacles to further separate the second particle group according to the distance over which the particles of the second particle group are projected/entrained by the flow of fluid jet momentum.

[00140] 12, A method for separating a particle stream into particle groups, comprising the steps of:

[00141] i) vertically diluting the particle stream by directing the particle stream ~~to~~ at a predetermined falling condition and velocity creating more space between particles within a passageway (20) dilution treatment chamber (12)) ~~channel~~;

[00142] ii) distributing ~~breaking down~~ the particle stream by subjecting the particle stream to high pressure fluid flow creating a jet shape and momentum force which

increase the kinetic energy of the flowing fluid, resulting in the expense of its pressure energy and the jet momentum which decelerate in short distance related to the magnitude of fluid flow force and with the surface area dimension of the nozzle outlet opening. This fluid flow jet momentum creates a lateral forces so as to distribute the particle stream over a surface area and within the volume of the passageway (20) dilution treatment chamber (12) ~~channel~~;

[00143] iii) projecting entraining a particle group away from a remainder of the particle stream by creating a fluid flow force of predetermined magnitude across the particle stream in said falling condition, impacting the particles which absorbs in part the momentum of fluid flow pressure to move a group of particle on a longer distance of the width dimension of the dilution treatment chamber, out of the dilution treatment chamber (12) to the transfer chamber (13); and

[00144] iv) collecting the particle group and the remainder of the particle stream at separate locations.

[00145] 13. The method according to claim 12, further comprising a step of ~~horizontally~~ diluting the particle stream by providing a horizontal velocity to the particle stream prior to step i).

[00146] 14, The method according to claim 12, wherein step ii) includes projecting/injecting a fluid flow into the particle stream to ~~break down said mass and~~ distribute the particle stream over the surface area and within the volume of the dilution treatment chamber (12) Passageway (20) ~~channel~~.

[00147] 15. The method according to claim 12, wherein step iv) includes collecting the particle group into at

least two particle subgroups by providing at least two collecting locations: one for the separated particle groups, and one for the remaining particle stream in the passageway (20) for the particle group, so as to collect particles in the subgroups according to the predetermined pressure, thus influencing the quantity and travelling distance ~~a distance~~ of entrainment and projection of the particles also in relation with their masses.

[00148] 16. An apparatus (10,10') according to claims 1-11, for at least one of ~~mixing and treating~~ separating particle and/or streams, comprising:

[00149] a dilution treatment chamber (12) defining an upstanding generally parallelepipedic passageway (20) ~~channel~~ having an inlet (21) at a top end, and an outlet (22), the passageway (20) ~~channel~~ being adapted to receive said particle and/or fluid streams at the inlet such that said particle and/or fluid streams fall toward the outlet (22);

[00150] at least one dilution treatment chamber fluid flow aperture (25) in the dilution treatment chamber (12), adapted to create a generally lateral flow of at least one of a fluid and particle jet within the passageway (20) dilution treatment chamber (12) ~~channel~~ to create a ~~turbulence~~ jet force magnitude, impacting the particle stream in the passageway (20) ~~channel~~ for at least one of ~~mixing~~ said particle and/or fluid streams and ~~treating~~ separating said particle and/or fluid streams, whereby a ~~mixture and/or treated~~ separated matter will exit the passageway (20) ~~channel~~ at the outlet (22); and

[00151] a positive pressure source connected to the nozzle inlet (40) and a nozzle outlet (41) connected to

the dilution treatment chamber fluid flow aperture (25) to create the lateral flow ~~of the~~ at predetermined pressure and magnitude at least one of the fluid and the particle jet.

[00152] 17. The apparatus (10,10') according to claim 16, further comprising a ~~particle~~ pre-treatment module (15) at the inlet(21) of the dilution treatment chamber (12), to cause a ~~horizontal~~ dilution of said particle and/or ~~agent~~ fluid streams.

[00153] 18. The apparatus (10,10') according to claim 17, wherein the particle pre-treatment module (15) has at least one slide (53) portion sloping downwardly toward the inlet (21) of the dilution treatment chamber (12) for guiding said particle and/or agent fluid streams to the dilution treatment chamber (12), and a deflector (51) surface between the slide (53) and the inlet for breaking down said particle and/or fluid streams and for imparting the dilution to said particle and/or fluid streams.

[00154] 19. The apparatus (10,10') according to claim 16, wherein a nozzle (14), (104) interconnects the pressure source to the dilution treatment chamber fluid flow aperture (25) so as to create the flow of fluid in the passageway (20) ~~channel~~ of the dilution treatment chamber (12).

[00155] 20. A method according claims 12 - 15 for at least one of ~~treating~~ separating ~~and mixing~~ particle and/or fluids streams, comprising the steps of:

[00156] i) vertically accelerating speed of particles stream due to gravity force for diluting particle and/or fluid streams so as to cause more and more space between

the particles by directing particle and/or fluid streams to a falling condition;

[00157] ii) creating a lateral flow of fluid jet and/or a particle jet across, impacting the particle and/or fluid streams in said falling condition for at least one of ~~mixing~~ the particle and/or fluid streams by a ~~turbulence~~ high pressure force of the fluid flow resulting from the lateral flow of fluid jet and/or particle jet, and ~~treating~~ separating said particle and/or fluid streams; and

[00158] iii) collecting the ~~mixture and/or treated~~ separated matter below the lateral flow of fluid.

[00159] 21. The method according to claim 20, further comprising a step of horizontally diluting the particle and/or fluid streams by providing a horizontal velocity to the particle and/or fluid streams prior to step i).

[00160] 22. An apparatus (10,10') according to claims 1-11, 16-19, wherein a generally parallelepipedic passageway (20) of the dilution treatment chamber (12) has a movable side wall (26), which adjusts the surface area and volume of the dilution treatment chamber (12), that increases and/or reduces the space between the particles and enhances different dilution rates influencing the need of the fluid flow jet force and the separating process of a particle stream.

[00161] 23. A method according to claims 12-15, 20, and 21 to enhance different dilution rates of a particle stream by increasing or reducing the surface area and volume of the dilution treatment chamber (12) by adjusting the surface area of the passageway (20) dilution treatment chamber (12), which affects the volume of the dilution treatment chamber (12) and increases or

reduces the space between the particles in the particle stream. Influencing the need of the fluid flow jet force and the separating process. This adjustment of the surface area of the dilution treatment chamber (12) also influences the needs of the jet pressure momentum transferred at the particles and the efficiency of the separation, ng, of a particle stream.

[00162] 24. An apparatus (10,10') according to claims 1-11, 16-19 and 22, wherein said apparatus for separating, a particle stream has the option of other configuration as shown (figure 10') directing the separated particles at a transfer plate, situated on the bottom end of the first transfer chamber (13), for distributing the separated particles in the second passageway (20'), which is positioned opposite to the first passageway (20), elongated for processing the separated particles, has a similar process for the particle stream, enhancing other separation of the separated particles into subgroups, and exits the apparatus interconnected by the outlet of the two passageways (20') and the transfer chamber (13') outlet.

[00163] 25. A method according to claims 12-15, 20, 21 and 23 for producing many different groups of particles from the particle stream by interconnecting, for instance, several similar apparatuses opposing the passageway (20') diluting treatment chamber (102), shown in Fig. 10', and transfer the separated particles to one other similar apparatus. Other configurations can be created by transferring by means of a passageway the separated particles and the particle stream components to another apparatus. Separated particles exit the transfer chamber (13') and are directed to another passageway

(20') inlet for the next separation, as similarly performed on the first apparatus, which results in remaining particle group exiting from the first passageway (20') and the other separated particles group into a subgroup; and one subgroup exiting the second passageway (20'), and the other one exiting the second transfer chamber (106),(13).

[00164] ~~26. An apparatus (10,10')according to claims 1-10, 16-19, 22, and 24, wherein said apparatus has the option of interconnecting several apparatuses in parallel, whether in different configurations, such as sharing the same transfer chamber (13) or nozzle (14), or back-to-back, front-to-front, or side-to-side, apparatus resulting in an increase in the amount of the particle stream to be processed.~~

[00165] 27. A method, according to claim 12-15,20,21,23,25 for separating a stream of particles having a cross sectional area, the stream of particles flowing substantially along a stream flow direction. The method includes: directing a flow of fluid towards the stream of particles, the flow of fluid flowing substantially along a flow of fluid direction, the flow of fluid having a pressure and magnitude such that the velocity produce a jet of the fluid which produces a force impacting on the particles causing the particles to move in a direction substantially parallel to the flow of fluid thereby increasing the cross sectional area and diluting the previous mass of the particles stream, and the separating, particles/fluids.

[00166] 28. An apparatus, according to claim 1-11,16-19,22,24 for separating a stream of particles having a cross sectional area, the stream of particles flowing

substantially along a stream flow direction. The method includes: directing a flow of fluid towards the stream of particles, the flow of fluid flowing substantially along a flow of fluid direction, the flow of fluid having a pressure and magnitude such that the velocity produce a jet of the fluid and produces a force impacting on the particles causing the particles to move in a direction substantially parallel to the flow of fluid thereby increasing the cross sectional area and diluting the previous mass of the particles stream, and the separating, particles/fluids.

[00167] 29. A method according to claims 12-15,20,21,23,25,27 where a fluid jet as a pressure source connected to a nozzle having a nozzle outlet opening which create a fluid jet at a high pressure producing the speed and momentum of the fluid jet, a jet being defined as a fast moving stronger fluid creating a high impact, creating the force, the magnitude and the configuration of the fluid jet, is a stream configuration produced by the cross sectional area of the nozzle outlet opening.

[00168] An apparatus for separating a particle stream into a first particle group and a second particle group, said apparatus being connectable to a positive pressure source, said apparatus comprising:

[00169] a dilution treatment chamber defining a passageway, said passageway being substantially upstanding and defining a passageway top end and a substantially opposed passageway bottom end, said passageway top end defining a particle inlet and said passageway bottom end defining a first-particle-group outlet for releasing the first particle group, said passageway being configured and sized to receive the

particle stream at said particle inlet such that the particle stream falls toward said first-particle-group outlet;

[00170] a transfer casing located substantially adjacent to said dilution treatment chamber, said transfer casing defining a transfer chamber provided for receiving the second particle group;

[00171] at least one second-particle-group outlet substantially laterally positioned with respect to said passageway, said at least one second-particle-group outlet extending between said transfer chamber and said passageway and allowing fluid communication therebetween;

[00172] a distributor located in said passageway between said particle inlet and said at least one second-particle-group outlet, said distributor being provided for breaking down the particle stream and distributing the particle stream horizontally within said passageway; and

[00173] at least one fluid flow aperture provided in said transfer chamber for creating a substantially horizontal fluid flow in said passageway, said at least one fluid flow aperture and said at least one second-particle-group outlet being located below said distributor, substantially horizontally aligned relatively to each other and located substantially opposed to each other relatively to said passageway, said fluid flow aperture being connectable to the positive pressure source to create the fluid flow;